(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 984 083 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.03.2000 Bulletin 2000/10

(51) Int. Cl.⁷: D01D 5/098

(21) Application number: 99306461.7

(22) Date of filing: 17.08.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 31.08.1998 US 143883

(71) Applicant: ILLINOIS TOOL WORKS INC.
Glenview, Cook County, Illinois 60025 (US)

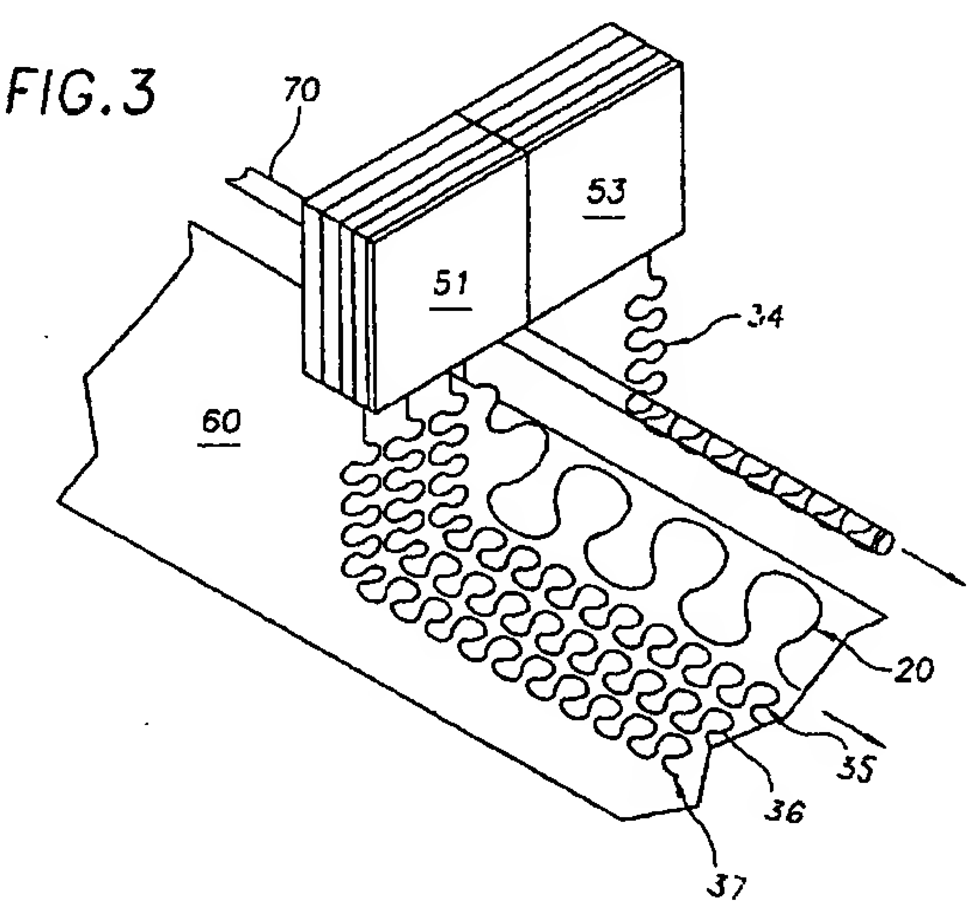
(72) Inventor: Kwok, Kui-Chiu
Mundelein, Illinois 60060 (US)

(74) Representative:
Rackham, Stephen Neil
GILL JENNINGS & EVERY,
Broadgate House,
7 Eldon Street
London EC2M 7LH (GB)

(54) Omega spray pattern and method therefor

(57) A method for producing visco-elastic fluidic material flows by drawing a visco-elastic fluidic material (12) with corresponding separate second fluid flows (14, 16) associated therewith to form a visco-elastic fibre (20) vacillating in a repeating, generally omega-shaped pattern having a bowed portion (22) with first (24) and second (26) side portions that first converge toward each other and then diverge outwardly in generally opposing directions. In one operation, the visco-elastic (20) fibre vacillating in the repeating, generally omega-shaped pattern is an adhesive material deposited onto woven and non-woven fabric substrates (60) and stretched elongated elastic strands in the manufacture of a variety of bodily fluid absorbing hygienic articles.

FIG.3



EP 0 984 083 A2

Description

[0001] This invention relates generally to the dispensing of visco-elastic fluidic materials, and more particularly to methods for producing vacillating visco-elastic fibres for application onto substrates and elongated strands and combinations thereof.

[0002] It is desirable in many manufacturing operations to form visco-elastic fibres or filaments, which are deposited onto substrates and elongated strands moving relative thereto. These operations include the application of fiberized adhesives, including temperature and pressure sensitive adhesives, onto substrates and elongated strands for bonding to substrates. Other operations include the application of non-bonding fiberized visco-elastic materials onto various substrates as protective overlays, for example onto sheet-like articles which are stacked or packaged one on top of another, whereby the non-bonding fiberized material provides a protective overlay or separating member between the stacked articles.

[0003] One exemplary bonding operation is the application of substantially continuous adhesive fibres onto woven and non-woven fabric substrates for bonding to other substrates and for bonding to overlapping portions of the same substrate in the manufacture of a variety of bodily fluid absorbing hygienic articles. The adhesive fibres may also be applied to elongated elastic strands for bonding to portions of the substrate, for example in the formation of elastic waist and leg band portions of diapers and other undergarments. Another exemplary adhesive fibre bonding operation is the bonding of paper substrates and overlapping portions of the same substrate in the manufacture of paper packaging, for example disposable paper sacks.

[0004] In many adhesive fibre bonding operations, including the exemplary bodily fluid absorbing hygienic article and paper packaging manufacturing operations, as well as many non-bonding operations, it is desirable to uniformly apply the visco-elastic fibres onto the substrate and to accurately control where on the substrate the visco-elastic fibres are applied. The uniform application of visco-elastic fibres onto substrates and elongated strands ensures consistent bonding between substrates, or overlapping layer portions thereof, and elongated strands. The uniform application of visco-elastic fibres onto substrates and elongated strands also economizes usage thereof. Accurately controlling where the visco-elastic fibres are applied onto the substrate ensures proper and complete bonding in areas where bonding is desired, provides a distinct interface between areas of bonding and non-bonding, and generally reduces substrate waste resulting from visco-elastic fibres applied uncontrollably to areas thereof outside or beyond the desired target or bonding areas.

[0005] In the manufacture of bodily fluid absorbing hygienic articles, it is desirable to provide maximum absorbency and softness of overlapping bonded substrates and at the same time provide effective bonding therebetween. It is also desirable to bond stretched elongated elastic strands relatively continuously along the axial length thereof for bonding onto substrates so that the stretched strands do not slip, or creep, relative to the substrate when the substrate and strand are later severed in subsequent fabrication operations. More generally, it is desirable to accurately and uniformly apply visco-elastic fibres onto substrates and elongated strands, without undesirable overlapping of adjacent fibres, and with well defined, or distinct, interfaces between substrate areas with and without fibre coverage. Similar results are desirable in the application of bonding and non-bonding fibres onto substrates and elongated strands used in operations besides the exemplary manufacture of hygienic articles.

[0006] In the past, visco-elastic fibres have been applied onto substrates with melt blowing and spiral nozzles. Conventional melt blowing and spiral nozzles however do not adequately satisfy all of the requirements in the manufacture of bodily fluid absorbing hygienic articles and other operations discussed generally above, or do so to a limited extent using adhesive excessively and inefficiently. Melt blowing nozzles generally dispense fibres chaotically in overlapping patterns, and spiral nozzles dispense fibres in overlapping spiral patterns. The fibre patterns produced by these conventional nozzles tend to stiffen the substrate, which is particularly undesirable in the manufacture of bodily fluid absorbing hygienic articles. The fibre patterns produced by conventional nozzles also tend to reduce the puffiness and hence softness of bonded substrates, or fabrics, which reduces the comfort thereof. Additionally, fibre patterns produced by conventional nozzles tend to reduce the absorbency of fabrics by obstructing the flow of moisture between layers, usually from the inner layers toward more absorbent outer layers. The conventional nozzles also apply fibres onto the substrate relatively non-uniformly, and lack precise control over where the fibres are applied onto substrates and elongated strands.

[0007] The present invention is drawn toward advancements in the art of producing visco-elastic fluidic material flows, and more particularly to methods for producing vacillating visco-elastic fibres for application onto substrates and elongated strands, and combinations thereof. It is an object of the invention to provide novel methods for producing vacillating visco-elastic fluidic material flows for application onto various substrates and elongated strands and combinations thereof that go at least some way towards overcoming the above mentioned and problems in the art.

[0008] According to a first aspect of this invention a method for producing visco-elastic fluidic material flow

comprises:

dispensing the visco-elastic fluidic material to form a first fluid flow at a first velocity;

dispensing a second fluid to form separate second fluid flows at a second velocity along generally opposing flanking sides of the first fluid flow; and

vacillating the first fluid flow with the separate second fluid flows to form a repeating generally omega-shaped pattern, the generally omega-shaped pattern having a bowed portion with first and second side portions, the first and second side portions converging toward each other and then diverging outwardly in generally opposing directions.

[0009] According to a further aspect of this invention an article of manufacture comprises:

a substrate having a first surface; and

a substantially continuous visco-elastic fibre disposed on the first surface of the substrate, the substantially continuous visco-elastic fibre formed in a repeating generally omega-shaped pattern, the generally omega-shaped pattern having a bowed portion with first and second side portions, the first and second side portions converging toward each other and then diverging outwardly in generally opposing directions.

[0010] A particular embodiment of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a perspective view of an apparatus for producing a visco-elastic fibre vacillating in a repeating, generally omega-shaped pattern according to a particular embodiment of the present invention;

Figure 2 is a partial view of the repeating, generally omega-shaped visco-elastic fibre pattern produced by the apparatus of Figure 1;

Figure 3 is an exemplary application of the visco-elastic fibres of Figure 2 onto a substrate and an elongated strand; and

Figure 4 is another exemplary application of the visco-elastic fibres of Figure 2 onto substrates and elongated strands.

[0011] Figure 1 shows an apparatus 10 for producing one or more visco-elastic fluidic material flows, or fibres, 20, which may be deposited onto substrates or elongate strands and which are useable in various bonding and non-bonding operations. The visco-elastic fluidic material is, for example, a polyethylene or polypropylene or other polymer formulated for bonding and/or non-bonding applications. These visco-elastic materials however are exemplary only, and are not intended to be limiting since any visco-elastic fluidic material that may be drawn into relatively continuous fibres or filaments are suitable for practicing the present invention.

[0012] In one exemplary operation, the visco-elastic fluidic material is a temperature or pressure sensitive adhesive useable for bonding overlapping substrates. These operations include, for example, applying adhesive fibres onto woven and non-woven substrates in the manufacture of bodily fluid absorbing hygienic articles, and onto paper substrates in the manufacture of paper packaging materials, and onto various other substrates, which are bonded with other substrates or with elongated strands. In another exemplary application, the visco-elastic fluidic material is a non-adhesive material deposited onto other substrates in non-bonding operations, for example as protective overlays between substrates, like glass and other materials.

[0013] Figure 1 illustrates the nozzle 10 producing a visco-elastic fibre 20 in a repeating, generally omega-shaped pattern. Figure 2 illustrates a segment of the repeating, generally omega-shaped pattern having a bowed portion 22 with first and second side portions 24 and 26 each shared with corresponding adjacent bowed portions 32 and 42 of adjacent segments of the pattern, which are illustrated in phantom lines. The first and second side portions 24 and 26 first converge toward each other and then diverge outwardly in generally opposing directions before merging with the corresponding adjacent bowed portions 32 and 42. According to the present invention, the

repeating, generally omega-shaped pattern of the fibres 20 are produced remarkably consistently and uniformly, and are particularly well suited for many bonding and non-bonding operations with significant advantages over conventional overlapping chaotic and spiral fibre patterns produced by conventional nozzles. Any reference in this specification to "omega" (for example, "an omega-shaped pattern") relate to the upper case Greek letter Omega (Ω).

[0014] In Figure 1, the repeating, generally omega-shaped pattern of the visco-elastic fibre 20 is produced generally by dispensing a visco-elastic fluidic material to form a first fluid flow 12 at a first velocity, and dispensing a second fluid to form separate second fluid flows 14 and 16 at a second velocity along generally opposing flanking sides of the first fluid flow 12. The separate second fluid flows 14 and 16 are located and oriented relative to the first fluid flow 12 to vacillate the first fluid flow 12 in a manner that produces the repeating, generally omega-shaped pattern.

[0015] The second fluid flows 14 and 16, which are preferably a gas (for example air), are spaced from the first fluid flow 12 and dispensed at a second velocity greater than a first velocity of the first fluid flow 12 so that the first fluid flow 12 is drawn by the separate second fluid flows and vacillated to form the visco-elastic fibre in the repeating, generally omega-shaped pattern 20 illustrated in Figures 1 and 2. The first fluid flow 12 and the separate second fluid flows 14 and 16 are preferably dispensed in a common plane, whereby the first fluid flow is vacillated to form the repeating generally omega-shaped pattern in the common plane containing the first and separate second fluid flows, illustrated best in Figure 1. In one mode of operation, the separate second fluid flows 14 and 16 are converged toward the first fluid flow 12 to form the fibre in the repeating, generally omega-shaped pattern 20. And in another alternative mode of operation, the separate second fluid flows 14 and 16 are dispensed parallel to the first fluid flow 12 to form the fibre in the repeating, generally omega-shaped pattern 20.

[0016] Generally, as the second velocity of the separate second fluids flows 14 and 16 increases relative to the first velocity of the first fluid flow 12, the first fluid flow 12 is correspondingly drawn increasingly and begins to vacillate back and forth with correspondingly increasing amplitude and frequency, as disclosed generally and more fully in the co-pending European Patent Application published as EP-A-872580. As the second velocity of the separate second fluid flows 14 and 16 increases further relative to the first velocity of the first fluid flow 12, the first fluid flow 12 begins to vacillate in the desired repeating, generally omega-shaped pattern 20. Further increases in the second velocity of the separate second fluid flows 14 and 16 relative to the first velocity of the first fluid flow 12 eventually results in a generally chaotic vacillation of the visco-elastic fibre, which may be desirable for some operations but is beyond the scope of the present application.

[0017] Figure 1 illustrates the visco-elastic fluidic material dispensed from a first orifice 52 in a body member 50, or die assembly, to form the first fluid flow 12, and the second fluid flow dispensed from two second orifices 54 and 56 in the body member 50 associated with the first orifice 52. The two second orifices 54 and 56 are disposed on generally opposing flanking sides of the first orifice 52, in a common plane, to form the separate second fluid flows 14 and 16 along generally opposing flanking sides of the first fluid flow 12. The body member 50 is preferably a parallel plate body member as disclosed generally and more fully in the above mentioned EP-A-872580.

[0018] In one exemplary adhesive dispensing operation suitable for the manufacture of bodily fluid absorbing hygienic articles, the orifices of the parallel plate die assembly are generally rectangular. More particularly, the adhesive orifices are approximately 0.022 inches (0.056 cm) by approximately 0.030 inches (0.076 cm) and the corresponding separate air orifices are approximately 0.033 inches (0.084 cm) by approximately 0.030 inches (0.076 cm). In the exemplary adhesive dispensing operation, the adhesive mass flow rate is approximately 10 grams per minute per adhesive orifice, and the air mass flow rate is approximately 0.114 cubic feet (3.23 litres) per minute for the two corresponding air orifices. Under these exemplary operating conditions, a repeating, generally omega-shaped pattern having a width, or amplitude, of approximate 0. 25 inches (0.64 cm) is produced when the air pressure is between approximately 3 psi (20.7kPa) and approximately 10 psi (68.9 kPa), with a preferable operating air pressure of approximately 6 psi (41.4 kPa). The air temperature is generally the same as or greater than the adhesive temperature, and may be adjusted to control the adhesive temperature, which is usually specified by the manufacturer.

[0019] These exemplary die orifice specifications are not intended to be limiting, and may be varied considerably to produce the repeating, generally omega-shaped pattern. The orifices may be formed in more conventional non-parallel plate die assemblies, and may be circular rather than rectangular. The air and adhesive mass flow rates, as well as the air pressure required to produce the repeating, generally omega-shaped pattern may also be varied outside the exemplary ranges. For example, the width of the amplitude and weight of the repeating, generally omega-shaped patterns 20 may be varied by appropriately selecting the air and adhesive orifice sizes and the controlling the air and adhesive mass flow rates. For many adhesive dispensing operations the amplitude of the repeating, generally omega-shaped pattern is generally between approximately 0.125 (0.318 cm) and 1 inches (2.54 cm), but may be more or less.

[0020] A body member 50, or die assembly, configured and operated as discussed above produces remarkably uniform and consistent repeating, generally omega-shaped pattern 20. Additionally, the amplitude and frequency of

the repeating, generally omega-shaped patterns 20 may be controlled relatively precisely as discussed above and more fully in the above mentioned EP-A-872580. Thus the repeating, generally omega-shaped pattern may be deposited onto a substrate or elongated strand with substantial uniformity and accuracy not heretofore available with conventional fibre or filament dispensing nozzles.

[0021] Figure 3 illustrates a first parallel plate die assembly 51 having nozzles for depositing multiple repeating, generally omega-shaped patterns 20 with differing amplitudes onto a substrate 60 moving relative thereto in a substrate coating operation. An alternative and equivalent is for the die assembly 51 to move relative to a fixed substrate. In the exemplary embodiment, the first fluid flows forming the repeating, generally omega-shaped patterns 20 are vacillated non-parallel to the movement direction of the substrate by the corresponding second fluid flows, and more particularly the first fluid flows are vacillated transversely to the movement direction of the substrate 60. This aspect of the invention is disclosed more fully in the above mentioned EP-A-872580.

[0022] According to the present invention, the repeating, generally omega-shaped patterns 20 may be deposited relatively continuously onto a surface of the substrate in single or multiple parallel patterns, which selectively cover the substrate as desired for the particular application. In Figure 3 for example, two or more repeating, generally omega-shaped patterns 35, 36 and 37 may be applied to the substrate 60 side-by-side providing relatively complete substrate coverage without undesirable overlapping there between. And in operations where some overlapping of adjacent fibre patterns 20 is desired, the extent of the overlap can be controlled relatively precisely in the practice of the present invention. This is due in part to the relatively consistent width of the fibres 20 produced, and also to the location accuracy with which the fibres 20 are applied onto the substrate.

[0023] Figures 3 and 4 illustrate also how the repeating, generally omega-shaped fibre patterns 20 provide excellent bonding without compromising absorbency and softness of the substrate, which is so desirable when bonding woven and non-woven fabric substrates in the manufacture of bodily fluid absorbing hygienic articles. More particularly, the repeating, generally omega-shaped fibre patterns 20 provide uniform substrate coverage with substantial adhesive bonding area, yet fibre overlapping is eliminated or at least reduced substantially where undesired. Thus the tendency of the fabric to stiffen due to globular and overlapping fibres is eliminated. The repeating, generally omega-shaped fibre patterns 20 also provide relatively large areas of adhesive non-coverage through which bodily fluids may flow unobstructed. These large areas of adhesive non-coverage also reduce the tendency of the woven and non-woven fabric substrates to flatten and lose puffiness, which otherwise occurs with fibres produced by conventional nozzles, thereby increasing the softness of the bonded substrates.

[0024] Figure 3 also illustrates a second parallel plate die assembly 53 depositing a repeating, generally omega-shaped fibre pattern 34 onto at least one isolated elongated strand 70 moving relative thereto in a strand coating operation. An alternative and equivalent is for the die assembly 53 to move relative to a fixed strand. According to the strand coating operation, the repeating, generally omega-shaped pattern is vacillated generally non-parallel, and in the exemplary operation transversely to, a direction of movement of the isolated elongated strand 70. The uniformity and consistency of the repeating, general omega-shape pattern ensures relatively uniform application thereof along the axial dimension of the elongated strand, which is particularly desirable in operations where the strand is a stretched elongated elastic strand subsequently bonded to some other substrate, thereby reducing the tendency of the bonded elongated strand 70 to thereafter creep relative to the substrate 60 when severed during subsequent fabrication operations. More generally, at least one repeating, generally omega-shaped fibre pattern may be deposited onto two or more isolated elongated strands moving relative thereto in a strand coating operation. Alternatively, multiple adjacent or overlapping repeating, generally omega-shaped fibre patterns may be deposited onto two or more isolated elongated strands moving relative thereto in a strand coating operation.

[0025] In one operation, the amplitude or width of the repeating, generally omega-shaped pattern 34 is selected so that substantially all of the visco-elastic material vacillating in the repeating, generally omega-shaped pattern is captured on or about an isolated elongated strand 70 as disclosed generally and more fully in the co-pending European Patent Application number 99105750.6 filed on 15 March 1999. The uniform width of the repeating, generally omega-shaped pattern 34 and the accuracy with which it is deposited makes possible the capture of substantially all of the fibre 34 onto the elongated strand 70, which is highly desirable in manufacturing operations and is a significant advantage over conventional elongated strand bonding operations.

[0026] Figure 4 illustrates another alternative operation wherein a repeating, generally omega-shaped fibre pattern 25 is deposited onto at least one corresponding elongated strand 71, which may be a stretched elongated elastic strand, disposed either directly on the substrate 60, or raised thereabove. The uniformity and consistency of the repeating, generally omega-shaped pattern ensures relatively uniform application thereof along the axial dimension of the at least one elongated strand 71. Also, the amplitude or width of the repeating, generally omega-shaped pattern 25 may be selected so that the repeating, generally omega-shaped fibre pattern just covers the elongated strand 71 widthwise, for example in a bonding operation whereby the fibre is an adhesive material, so that the elongated strand 71 is effectively stitched to the substrate 60.

[0027] In another operation, a single repeating, generally omega-shaped pattern 29 may be deposited onto two or

more elongated strands 72 and 74 disposed either directly on the substrate 60, or raised thereabove. And in other operations, two or more repeating, generally omega-shaped patterns 27 and 28 may be deposited, either adjacently or overlappingly, as illustrated, onto multiple elongated strands 76, 77 and 78 disposed either directly on the substrate 60, or raised thereabove. The width and weight of the repeating, generally omega-shaped fibre patterns, and the location of deposition thereof onto the strand and/or substrate of course, depends on the configuration of the die assembly 50 as discussed herein above.

[0028] While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific exemplary embodiments herein. The invention is therefore to be limited not by the exemplary embodiments herein, but by all embodiments within the scope and spirit of the appended claims.

Claims

1. A method for producing a visco-elastic fluidic material flow comprising:

   dispensing the visco-elastic fluidic material to form a first fluid flow (12) at a first velocity;

   dispensing a second fluid to form separate second fluid flows (14, 16) at a second velocity along generally opposing flanking sides of the first fluid flow (12); and

   vacillating the first fluid flow (12) with the separate second fluid flows (14, 16) to form a repeating generally omega-shaped pattern (20), the generally omega-shaped pattern (20) having a bowed portion (22) with first (24) and second (26) side portions, the first (24) and second (26) side portions converging toward each other and then diverging outwardly in generally opposing directions.

2. The method of claim 1 wherein said first fluid flow (12) comprises a plurality of separate fluid flows at said first velocity and said second fluid flows (14, 16) comprise a plurality of separate second fluid flows at said second velocity wherein each of the first fluid flows (12) is flanked on substantially opposing sides by corresponding second fluid flows (14, 16) associated therewith.

3. The method of either of claims 1 or 2, further comprising drawing the or each first fluid flow (12) with the or each of the corresponding separate second fluid flows (14, 16) at the second velocity greater than the first velocity of the or each first fluid flow (12) to form visco-elastic fibre vacillating in the repeating generally omega-shaped pattern (20), wherein the or each of the separate second fluid flows (14, 16) are air flows.

4. The method of any one of the preceding claims further comprising dispensing the or each first fluid flow (12) and the or each of the separate second fluid flows (14, 16) in a common plane, and vacillating the or each first fluid flow (12) to form the repeating generally omega-shaped pattern (20) in the common plane containing the first (12) and separate second (14, 16) fluid flows.

5. The method of any one of the preceding claims further comprising converging the or each of the separate second fluid flows (14, 16) toward the or each corresponding first fluid flow (12) to vacillate the or each first fluid flow (12) and form the repeating generally omega-shaped pattern (20).

6. The method of any one of claims 1 to 4, further comprising dispensing the or each of the separate second fluid flows (14, 16) parallel to the or each first fluid flow (12) to vacillate the or each first fluid flow (12) and form the repeating generally omega-shaped pattern (20).

7. The method of any one of the preceding claims, further comprising dispensing the visco-elastic fluidic material from a or a plurality of separate first orifices (52) in a body member (50) to form the or each first fluid flow (12), and dispensing the second fluid (14, 16) from two second orifices (54, 56) in the body member (50) associated with each first orifice (52), the two second orifices (54, 56) disposed on generally opposing flanking sides of each first orifice (52) to form the or each of the separate second fluid flows (14, 16) along generally opposing flanking sides of the or each corresponding first fluid flow (12).

8. The method of any one of the preceding claims, further comprising depositing the repeating generally omega-

shaped pattern (20) of the or each vacillating first fluid flow (12) onto a substrate (60) moving relative thereto.

9. The method of any one of claims 1 to 7, further comprising depositing the repeating generally omega-shaped pattern (20) of the or each vacillating first fluid flow (12) onto at least one elongated strand (70, 71, 72, 74, 76, 77, 78) moving relative thereto.

10. The method, of claim 9 further comprising depositing the repeating generally omega-shaped pattern (20) of the or each vacillating first fluid flow (12) onto at least one stretched elongated elastic strand (70, 71, 72, 74, 76, 77, 78) disposed on a substrate (60).

11. The method of either one of claims 9 or 10 further comprising vacillating the or each first fluid flow (12) non-parallel to a direction of movement of at least one isolated elongated strand (70, 71, 72, 74, 76, 77, 78), and capturing substantially all of the visco-elastic fluidic material on the at least one isolated elongated strand (70, 71, 72, 74, 76, 77, 78).

12. The method of any one of claims 9 to 11 further comprising depositing at least one repeating generally omega-shaped pattern (20) of the or each vacillating first fluid flow (12) onto at least two isolated elongated strands (70, 71, 72, 74, 76, 77, 78).

13. An article of manufacture comprising:

a substrate (60) having a first surface; and

a substantially continuous visco-elastic fibre (20) disposed on the first surface of the substrate (60), the substantially continuous visco-elastic fibre (20) formed in a repeating generally omega-shaped pattern (20), the generally omega-shaped pattern (20) having a bowed portion (22) with first (24) and second (26) side portions, the first (24) and second (26) side portions converging toward each other and then diverging outwardly in generally opposing directions.

14. The article of claim 13, further comprising the substrate (60) is a fabric material useable in the manufacture of bodily fluid absorbing hygienic articles.

15. The article of claim 13, further comprising the substrate (60) is a paper material useable in the manufacture of packaging.

16. The article of any one of claims 13 to 15 further comprising a plurality of substantially continuous visco-elastic fibres (20) disposed on the first surface of the substrate (60), each of the substantially continuous visco-elastic fibres (20) formed in a repeating generally omega-shaped pattern (20) and arranged generally parallel.

FIG. 1

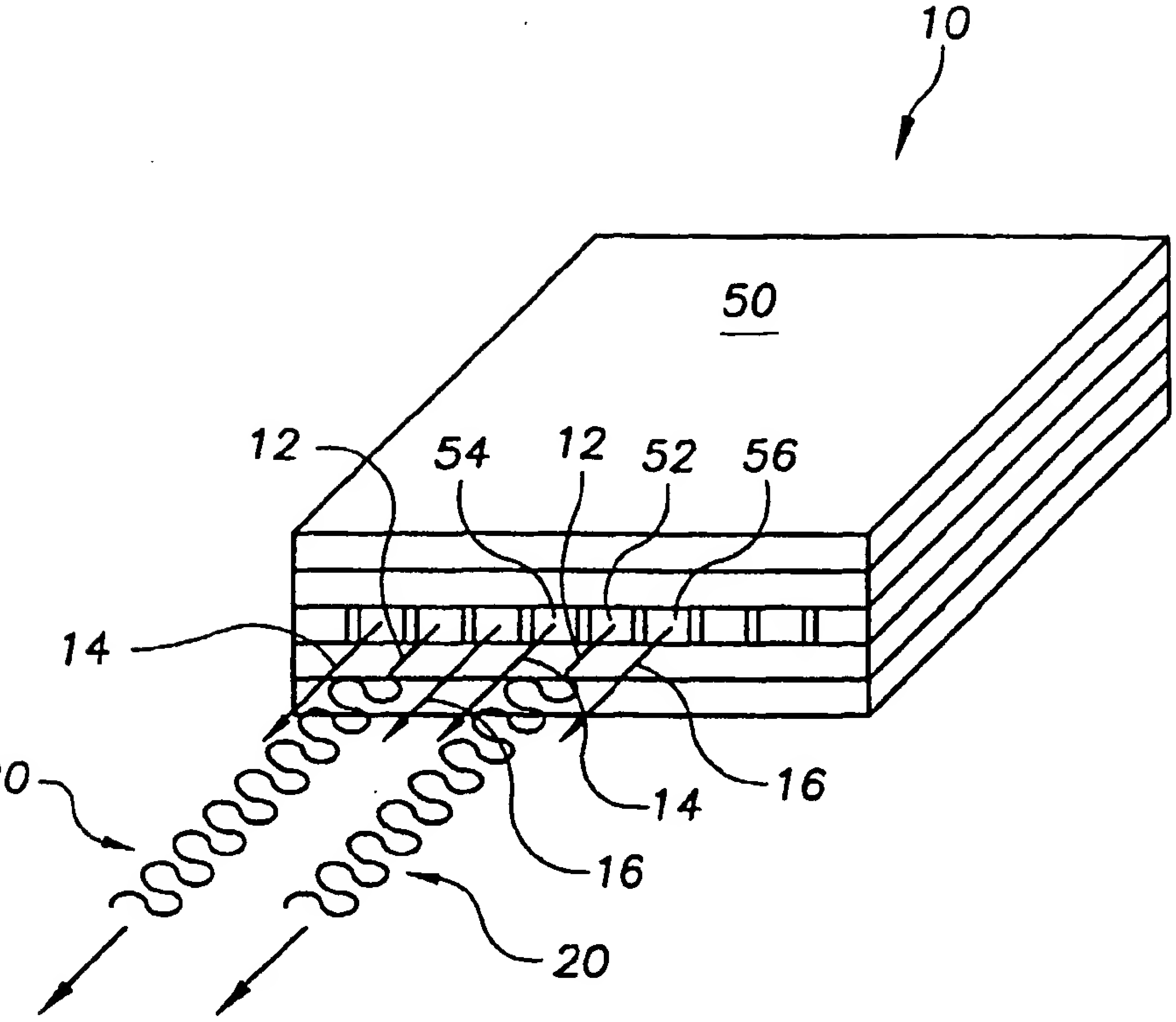


FIG. 2

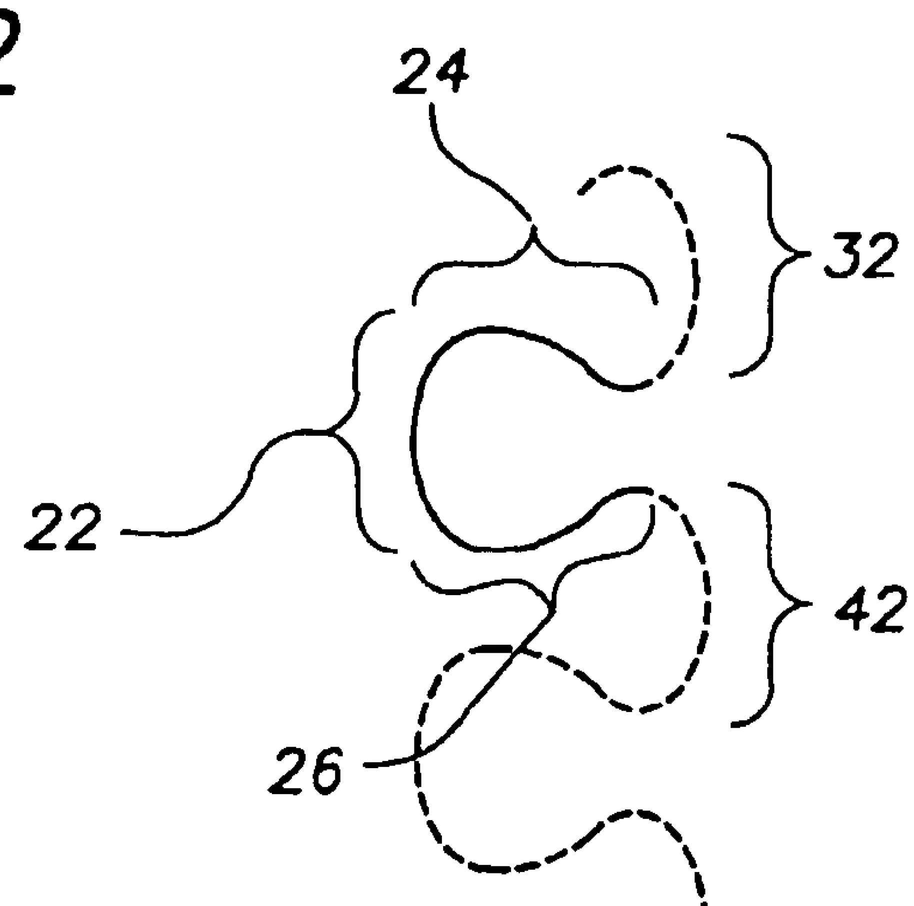


FIG.3

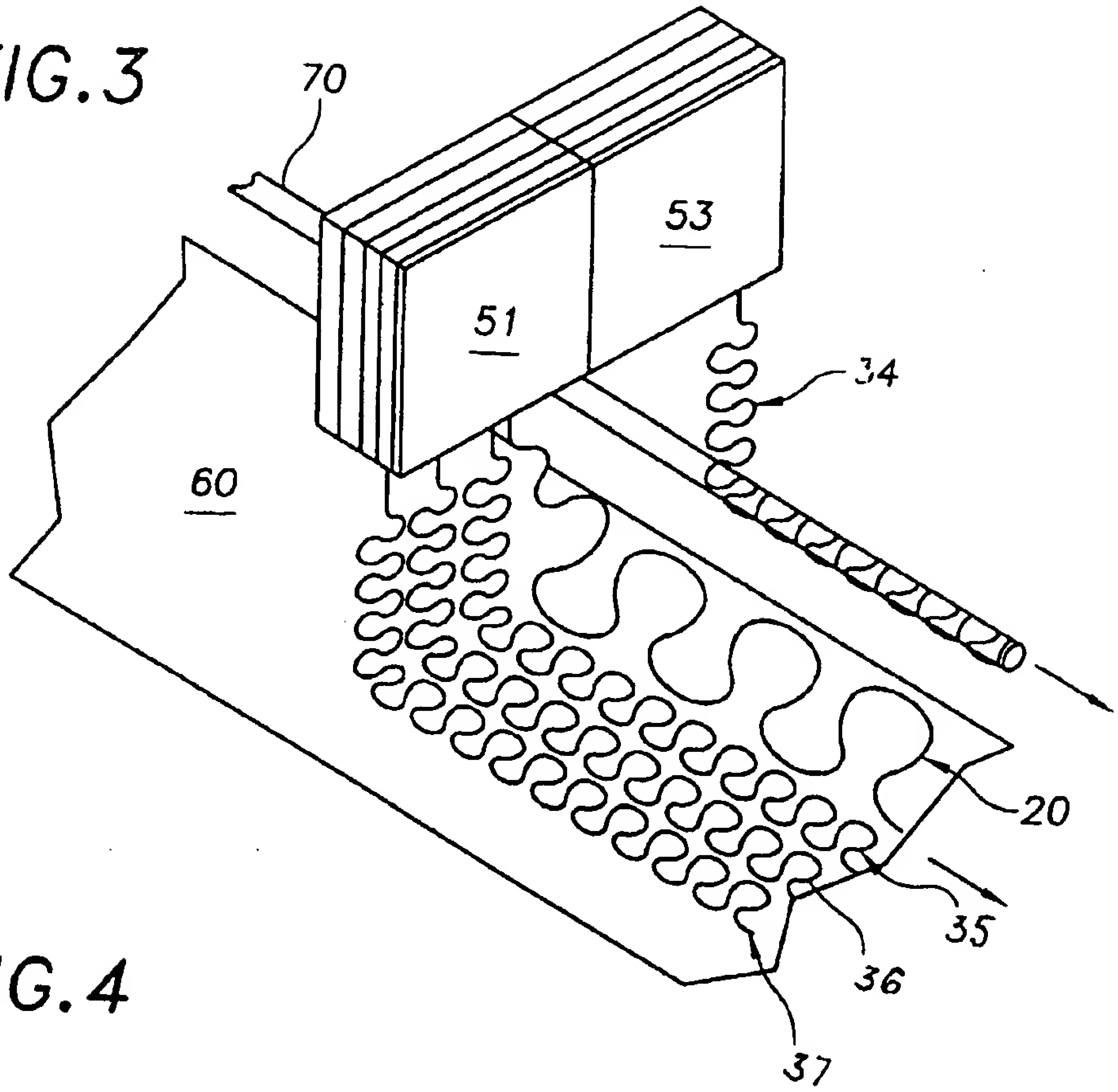


FIG.4